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HESSE-EASTERN

A DIVISION OF
FLIGHTEX FABRICS INC.
CAMBRIDGE, MASS.
EVERETT, MASS.

Received 12/24/58 1500

PRODUCT PROCESS Engineering

REPORT NO. 11-8-50G-1

MONTHLY PROGRESS REPORT

ENGINEERING PROGRAM FOR THE
DEVELOPMENT OF A LIGHTWEIGHT
ANTI-TANK ROCKET

FOR THE PERIOD

MONTH OF NOVEMBER 1958

CONTRACT NO. RD-142

[redacted]

[redacted]

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HESSE - EASTERN DIVISION

FLIGHTEX FABRICS, INC.

PROGRESS REPORT #15

ENGINEERING PROGRAM FOR THE DEVELOPMENT OF A LIGHTWEIGHT ANTI-TANK ROCKET

NOVEMBER 1958

CONTRACT NO. RD-142

PREPARED BY_____
Thomas Forman
Project Engineer

APPROVED BY_____
Charles B. Weeks
General Manager

SUBMITTED BY: HESSE-EASTERN DIVISION
FLIGHTEX FABRICS, INC.
EVERETT, MASSACHUSETTS

Hesse-Eastern

WORK DONE DURING THE MONTH OF NOVEMBER 1958

SYSTEM EVALUATION PROGRAM

Accuracy tests at both cold and hot temperatures have been conducted with complete weapon systems. Some minor problems have been encountered with the ignition system and overcome. Fuze tests have been conducted, and arrangements are under way to provide 7 complete systems for a demonstration by your agency.

MOTOR DEVELOPMENT PROGRAM

Accuracy and Ignition

Three accuracy tests were conducted in November. The first test took place on 7 November. The following is a tabulation of this test:

Round No.	Temperature	Vel. F/S	Comments
347	-30°	309	Part of igniter in motor high on target.
348	-30°	296	Part of igniter in motor body.
349	-30°	276	Part of igniter in motor body.
350	-30°	296	Part of igniter in motor body.

(Continued)

Round No.	Temperature	Vel. F/S	Comments
351	-30°	308	Part of igniter in motor body.
352	-30°	260	Part of igniter in motor body.
353	-30°	248	Went over target. Questionable propellant. Part of igniter in motor. Very heavy erosion.
354	-30°	286	Part of igniter in motor.
355	+120°	---	Motor failure. A dent in the motor was observed and noted prior to firing this motor. The motor had been re-used 3 times previously.
356	+120°	296	No comment.
357	+120°	---	Motor failure. Motor re-used twice before dent on motor marked prior to firing.
358	+120°	286	No comment.
359	+120°	296	No comment.
360	+120°	283	No comment.
361	+120°	286	No comment.

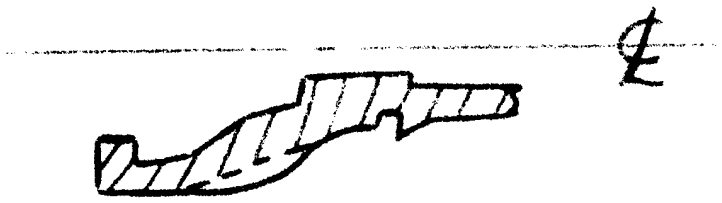
Photograph No. 141 is enclosed in the appendix. This photograph has a 6" grid super-imposed to give a clear picture of the target configuration which can be used for evaluation of the accuracy of the round. The spread in this group may be somewhat excessive for two reasons:

1. Faulty propellant in Round No. 248 which was picked out of an old unmachined batch by mistake.

2. The igniter parts which were to be found in the cold motors.

The motor failures appear of no importance since re-used motors which had previously been marked as questionable were used. Due to the waiting time before extruded motors are available and statically tested, this re-use of machined motors is unavoidable. In addition to this, the hard anodizing process used on these motors in order to enable us to re-use them increases their brittleness considerably, i.e., it decreases the differential between yield and ultimate strength.

In trying to evaluate the difficulties encountered with the igniters, it was found that only a very small number of igniters had been fired at the cold temperatures. Igniter push-out tests at cold temperature were immediately conducted. (See tabulation in appendix) This was done by means of placing igniters into a cold box at the temperature of -20° in the laboratory and pushing them through using the standard igniter fixture. A tabulation of the results of these tests is shown in the appendix. It was found that by machining a small angle off the igniter cap a decrease in push-through pressure could be obtained. This modification was put into effect on 10 igniters, and another ignition and accuracy test was conducted on 14 November. The modification to the igniter is shown in the following sketch:

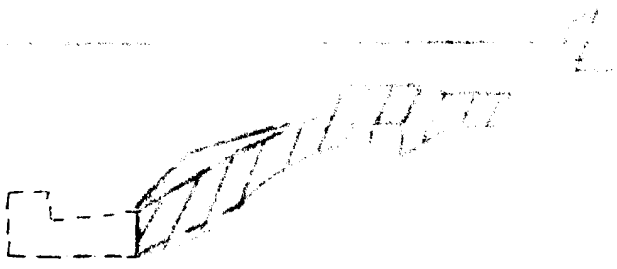


The following is a tabulation of the test results:

Round No.	Temperature	Vel. F/S	Comments
362	-20°	296	No igniter part in motor.
363	-20°	286	Igniter part still in motor.
364	-20°	286	No igniter part in motor.
365	-20°	286	Part of igniter in motor.
366	-20°	296	Part of igniter in motor.
367	-20°	309	No igniter part in motor.
368	-20°	334	No igniter part in motor.
369	+120°	320	No igniter part in motor.
370	+120°	320	No igniter part in motor.
371	+120°	335	No igniter part in motor.

See Photograph No. 142 in appendix.

In evaluating the results of this test, it appears that the modification to the igniter has produced some improvement. However, it was insufficient. The ridge on the inside of the powder cup in the igniter (see following sketch) was then removed and the method of wrapping polyethylene over the igniter reverted to. Another accuracy test, this time at 50 meters, was conducted, and the following is a tabulation of the results:



Round No.	Temperature	Vel. F/S	Comments
372	-20°	286	No comment.
373	-20°	286	No comment.
374	-20°	295	No comment.
375	-20°	383	No comment.
376	-20°	295	No comment.
377	-20°	306	No comment.
378	-20°	306	No comment.
379	+120°	305	No comment.
380	+120°	307	No comment.
381	+120°	296	No comment.

Photograph No. 143 shows the target obtained in this test.

This was the first test when the 50-meter target was available. As can be seen from the photograph, the group is extremely satisfactory. The igniter problem appears to have been solved. One more similar test will be conducted in December for further confirmation.

Model No. 4 fuzes were used in all rounds in this test. However, the fuze results will be discussed under the fuze section. An additional test on 28 November was conducted, again with complete systems. This time the test was a pure fuze test for graze sensitivity of the Model No. 4 fuze. Igniters used in this test, which was conducted at ambient temperature, were the latest configuration, and no igniter parts remained in the motors.

It is felt that the breaking off of part of the igniter was due to a stress concentration caused by the ridge inside the cup. Drawing Nos. C8120-9, 10

in the appendix shows the old and the new configuration in the igniter cup.

Procurement of Motor Parts

One extruded motor was delivered by Harvey Aluminum, Inc., as a sample. However, they are still working on improving the physical characteristics of the material. It appears that we will have a small number of extruded motor bodies available for our inspection and tests in the first week of December.

Propellant

Since the extruded propellant has not been received to date, propellant still has to be machined for tests. Propellant for the demonstration will be machined propellant. This will be done in order to eliminate any possibility of unforeseen changes in propellant characteristics since there will not be time to run static and dynamic tests with the new propellant, even if it should arrive in time.

WARHEAD DEVELOPMENT PROGRAM

Thirty-five warheads have been poured at Universal Match Corporation, and we understand that they were shipped on 20 November. These heads are expected at our Range in the first week of December. If it should be found that there is more delay than that, unloaded heads will have to be sent to us from

Eastern Tool & Mfg. Company and loaded at our Range in order to be able to produce the necessary quantity of fully loaded weapon systems for the demonstration.

FUZE DEVELOPMENT PROGRAM

Two fuze tests were conducted during November with Model No. 4 fuze. Fixtures for facilitating the fuze assembly were designed and manufactured and have helped greatly in speeding up the assembly. A torque spring has also been incorporated in the rotor shaft in order to make arming more positive. Twenty fuzes were assembled and tested in two tests, tabulations of which follow:

Fuze Test 21 November 1958

Fuzes used in conjunction with accuracy test. This provides a pure fuze functioning test. Heavy cardboard target at 50 meters. For accuracy and velocity, see Motor Section of this report.

Round No.	Temperature	Results
372	-20	Fuze operated when hitting ground.
373	-20	Fuze not set back.
374	-20	Fuze operated when hitting ground.
375	-20	Fuze armed. Failed to fire when hitting ground.
376	-20	Fuze operated when hitting ground.

(Continued)

Round No.	Temperature	Results
377	-20	Fuze operated when hitting ground.
378	-20	Fuze operated when hitting ground.
379	+120	Fuze operated when hitting ground.
380	+120	Fuze operated when hitting ground.
381	+120	Fuze operated when hitting ground.

See Photograph No. 143 in the appendix.

Fuze Test 28 November 1958

All rounds fired for graze functioning. Launcher depressed approximately 3°. Rounds grazed hard earth at 50 - 60 feet from launcher.

Round No.	Fuze No.	Results
382	10	Fuze armed. Did not operate on graze. Operated on 6" drop.
383	9	Fuze armed. Firing pin forward, in detonator, without setting it off.
384	31	Fuze operated on graze.
385	32	Triggering components set back. Rotor not armed. Firing pin not released.
386	35	Operated on third bounce.
387	33	Fuze did not set back.
388	27	Fuze did not go off until hitting 100 yard mound (third bounce).

(Continued)

Round No.	Fuze No.	Results
389	34	Fuze did not function. Dropped 4" on nose of round, whereupon it functioned.
390	30	Operated after repeated contact with ground.
391	37	Operated on second bounce.

Evaluation of Test Results

Round Nos. 373 and 387 failed to set back. Round Nos. 375, 382, and 389 failed to set off the detonator and needed an additional impact consisting of a drop of up to 6" in order to release the firing pin and initiate the detonator.

Round No. 383 functioned completely. However the firing pin had not pierced the detonator, and the fuze initiated its detonator when dropped from a height of 24".

Round No. 385 failed to arm.

These tests show four distinct problems:

1. Graze sensitivity
2. Setting back of the triggering components.
3. Arming.
4. Initiating the detonator.

To No. 1: Study of the fuze drawings has shown that the possibility exists for the two pins projecting from the triggering sleeve to catch in the cross hole located in the inertia element after the locking balls have been

released. This situation could cause a failure of the triggering sleeve to release when some of the force pulling it off the balls is not in a forward direction. This would be the case on many occasions when rounds graze the earth at different angles of obliquity. A change is being made in the pins and the ends made longer in order to rule out this possibility. A static fixture is going to be made which will make it possible to drop fuzes at different angles in order to simulate graze conditions.

To No. 2: This problem is felt to be a minor one, and the configuration of the locking spring and the depth of the groove in the inertia element holding the locking spring are being investigated. Upon examination of the locking springs at hand, it appears that some springs have flats on the open ends and will therefore not conform to the bore of the fuze housing as they should. This may cause catching and binding. Steps are being taken to eliminate this possibility. The possibility of hard anodizing the fuze housing is also being contemplated. This would decrease the co-efficient of friction between the fuze housing and the locking spring and facilitate set back.

To No. 3: The cause for this difficulty has been clearly established. A groove located in the rotor shaft which used to serve the purpose of holding a snap ring can get displaced sideways a sufficient amount to enable it to catch in one of the rotor bearings. This groove is no longer required, and rotor shafts with grooves were used since they were available. New rotor shafts are being made in which this groove has been eliminated.

To No. 4: If this condition should be found again, a change in the strength of the firing pin spring will be indicated. However, it is possible

that a faulty spring may have caused this failure. Springs will be more closely inspected when assembling fuzes in the future.

It is planned to conduct a fuze test incorporating all the above improvements.

The time element in ordering parts for final fuzes is beginning to be of extreme importance. Since a certain amount of time (approximately 2 months) will have to be allowed for final engineering tests with the fuze in order to make any necessary minor adjustments and to get a larger statistical background, final fuze components will have to be ordered before February, 1959. If the improvements which are now being worked on should fail to produce a sufficiently good result, the decision will have to be made to abandon Model No. 4 fuze, and Model No. 3 fuze will have to receive its final check-out. A greater number of firings with Model No. 3 fuze would be desirable if it were to be adopted for the weapons system. Model No. 3 fuze is being used in the systems supplied to you for the demonstration in December, and a total of 30 sets of components is being manufactured.

LAUNCHER DEVELOPMENT PROGRAM

The finalizing part of the work on the launcher was completed during the month. The trajectory of the round was plotted with an assumed velocity of 260 feet per second as an average, and sights for 50 meters were established. These sights have been checked out in a dynamic test (see Motor Development Program and Photograph No. 142 in the appendix, Round Nos. 372 through 380). It appears that the sights as developed are correct, and the

necessary revision to the final drawings has been made. Orders have been placed for components for the required number of launchers to complete the environmental test program and to deliver 100 launchers. A new side fastener has been designed. It consists of screw machine parts and incorporates small pins which provide positive location for the bands engaging in holes in the launcher wall. Twenty sets of the new fasteners have been incorporated in the launchers used for current tests. The 20 launcher systems have been re-used more than 5 times without any ill effects. Twenty new launcher tubes have been received from the Richardson Company and are being hydrostatically tested.

Two motor failures occurred in Round Nos. 355 and 357. Both launchers stood up to this condition in a way which gives reason to believe that the gunner would have been unharmed. Round No. 355 showed a crack in the launcher tube. Round No. 357 showed no damage to the launcher, and this launcher has been re-used since then. Tests with heat heads under similar conditions are being planned.

A certain amount of trouble has been experienced with the ignition both from the point of view of the igniter configuration and from the point of view of the firing pin spring. The igniter configuration has been fully discussed in the Motor Section. The trouble with the firing pin spring was experienced when checking out systems in the laboratory. Upon examining the propellant, it was found that the tolerances of the igniter parts were such as to make it possible for the spring to be incompletely pre-stressed when assembling. A very minor change had to be made in the length of the liner in

which the firing pin rides in order to eliminate this possibility. An aluminum washer is being placed against the back of the firing pin spring since it appeared that the firing pins were making too much of an impression in the polyethylene caps. After incorporating these changes, no further problems were encountered, and no problems of any sort were encountered in dynamic firings. All rounds reported in this report were fired using complete systems.

The immediate effort on the launcher program will now be directed toward establishing a controlled inventory of components, design and manufacture of the necessary fixtures and beginning to plan the environmental test program. A certain number of fixtures will also be required for this program.

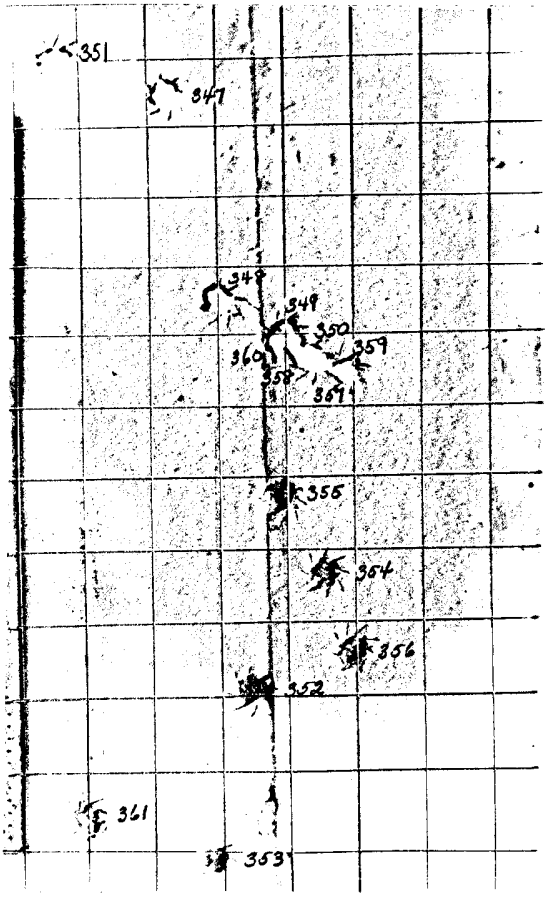
Charles B. Weeks
General Manager

Evaluated vs. Costs Expended for the Month:

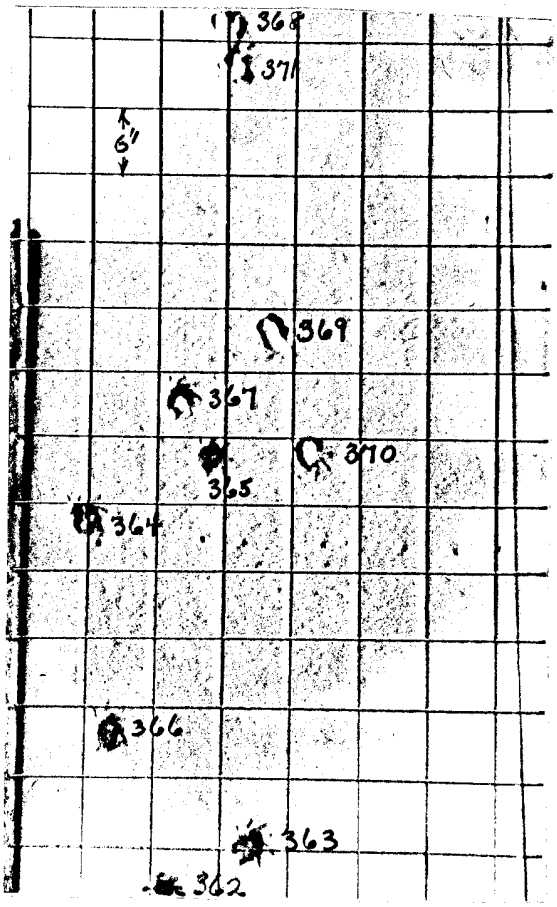
$14,364.65

Thomas Forman
Project Engineer

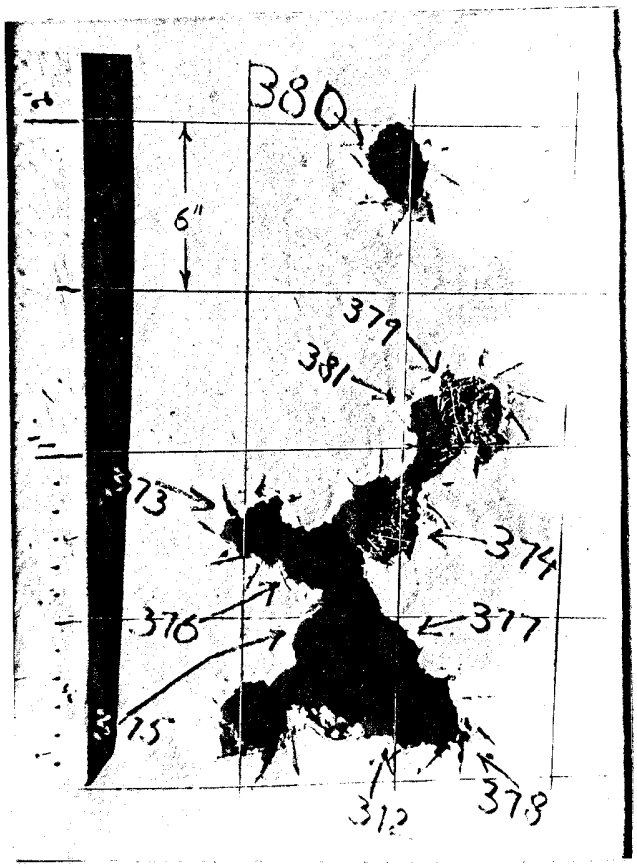
PHOTOGRAPHS



Photograph No. 141



Photograph No. 142



Photograph No. 143

IGNITER PUSH-THROUGH TEST - NOVEMBER 10, 1958

	Type	Press. Req'd	Comments
1.	Latest type. Without hole for 25 calibre cartridge. No groove for retaining ring. No retaining ring.	15 lbs.	Passed through the throat slowly.
2.	Cut off at black power level. Contained 25 calibre cartridge, firing pin, firing pin sleeve, and cap.	15 lbs.	Fast.
3.	Latest type igniter. Contained 25 calibre cartridge, firing pin sleeve, and cap. Hex cap to hold sleeve and primer from sliding through.		
4.	Same as No. 1.	18 lbs.	Fast.
5.	Igniter cut off at black powder level. Contained 25 calibre cartridge, primer, sleeve, and cap. Temperature: -10°.	15 lbs.	
6.	Latest igniter. Contained 25 calibre cartridge, sleeve, and hex cap. Temperature: -10°.	18 lbs.	Sheared at under-cut of retaining ring.
7.	Same as No. 2. Temperature: -20°.	15 lbs.	Slow.
8.	Latest igniter. Rib removed from restraining ring. Temperature: -20°.	18 lbs.	15 lbs. would not push through. Jumped it to 18 lbs. before temperature change.
9.	Cut off at black powder level. Contained primer, sleeve, and cap.	15 lbs.-no go 16 lbs.-go	
10.	New type. 9° machined on outside. Contained 25 calibre cartridge, sleeve, and cap. New restraining ring.	15 lbs.(slow)	Igniter went through nozzle. Restraining ring hung on in the groove. Started to shear at the groove.
11.	Same as No. 10. Removed the rib in the restraining ring.	15 lbs.(fast)	Igniter went through the nozzle. Did not shear. Restraining ring popped out of the groove.

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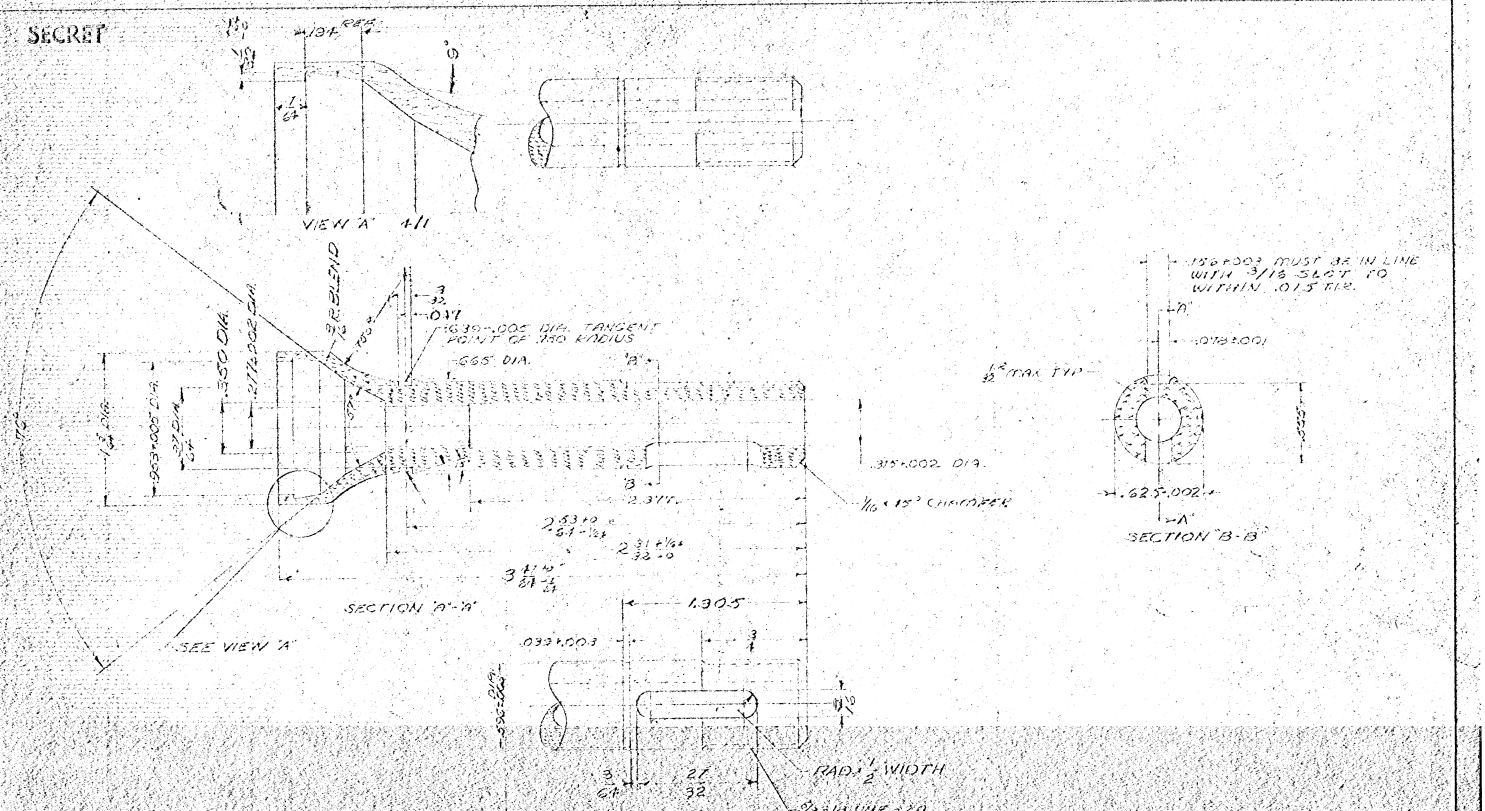

NOTES:
1. MATERIAL - SOLVETIZED END
2. PHYSICAL PROPERTIES -
   A. TENSILE STRENGTH - 2100/2500 PSI
   B. COMPRESSION STRENGTH - 1950 PSI
   C. FLEXURAL STRENGTH - 1000/1200 PSI
   D. IMPACT VALUE - 1.5 FT LB/IN
   E. ROCKWELL HARDNESS - R93/103 (SHORE)

REVISIONS	BY	DATE
DO NOT SCALE DRAWING		
ALL DIMENSIONS APPLY AFTER PLATING		
125 FINISH ALL OVER EXCEPT WHERE NOTED		
BREAK ALL SHARP CORNERS .005—.010		
STANDARD TOLERANCES: DECIMAL ±.005; FRACTIONAL ±1/64; ANGULAR ±1°; ALL DIA. ON SAME ℄ TO BE CONCENTRIC WITHIN .005 T.I.R. UNLESS OTHERWISE NOTED		

HESSE-EASTERN DIVISION
OF FLIGHTEX FABRICS, INC.
CAMBRIDGE 38, MASS.

IGNITOR BODY
IGNITOR ASSY
M-4

DR.			
CH'K'D			
ENG'R			
APP'D			
PROJ. 500 /	ASSY DWG B-8438		REV
SCALE 2x /	REF DWG C-8417		

C 8120

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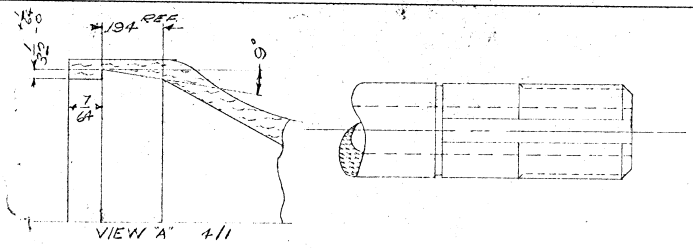

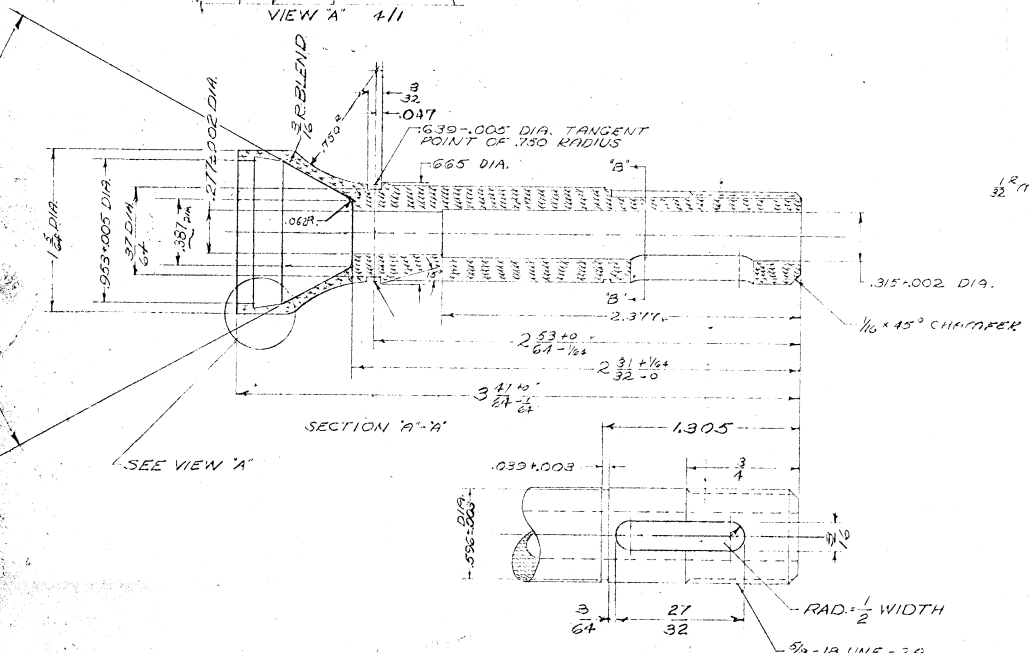

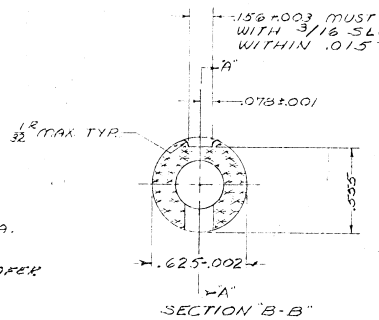

NOTE:
1. MATERIAL - POLYETHELENE
   PHYSICAL PROPERTIES
   A. TENSILE STRENGTH - 2300/3500 P.S.I.
   B. COMPRESSION STRENGTH - 1950 P.S.I.
   C. FLEXURAL STRENGTH - 4800/7000 P.S.I.
   D. IMPACT VALUE - .51/5 FT. LB/IN.
   E. ROCKWELL HARDNESS - D63/70 (SHORE)

10	Redrawn	K 7/19/58
9	Redrawn	T.F. Mills

REVISIONS

DO NOT SCALE DRAWING

ALL DIMENSIONS APPLY AFTER PLATING

125 FINISH ALL OVER EXCEPT WHERE NOTED

BREAK ALL SHARP CORNERS .005—.010

STANDARD TOLERANCES
DECIMALS ± .005
FRACTIONS ± 1/64
ANGULAR ± 1°
ALL DIA ON SAME ℄ TO BE CONCENTRIC WITHIN T.I.R UNLESS OTHERWISE NOTED

HESSE—EASTERN, DIVISION OF FLIGHTEX FABRICS, INC.
CAMBRIDGE 38, MASS.

IGNITOR BODY, IGNITOR ASS'Y
M-4

PROJ. 306-1	ASSY DWG B-8433	BY	R.F. 7/16-58
SCALE 2x1	REF DWG D8414	CH'K'D	K 7/16/58
MAT'L. NOTED		ENG'R	T.F. 7/16/58
		APP'D	C.B. 7/16/58

C 8120 REV. 10

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